UNICO 1100 SERIES

SPECTROPHOTOMETER

Model 1100 and Model 1100RS

SERVICE MANUAL

UNITED PRODUCTS & INSTRUMENTS INC.

182 Ridge Road, Suite E
Dayton, NJ 08810, USA
TEL: 732-274-1155 FAX: 732-274-1151
http://www.unico1.com

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1. GENERAL

1.1 Introduction

*The **UNICO**® Model 1100 Series spectrophotometers are single beam general purpose instruments designed for use in conventional laboratories. The instruments are ideal for various applications such as: Clinical Chemistry, Biochemistry, Food and Beverage Laboratories, Environmental Protection, Water and Waste Water Labs, and other fields of quality control.*

*The **UNICO**® 1100 Series spectrophotometers cover the visible wavelength range from 335 nm to 1000 nm. The analytical grating system has 1200 lines/mm for higher dispersion of the spectrum. Figure 1-1.1 and Figure 1-1.2 show Model 1100 and Model 1100RS respectively.*

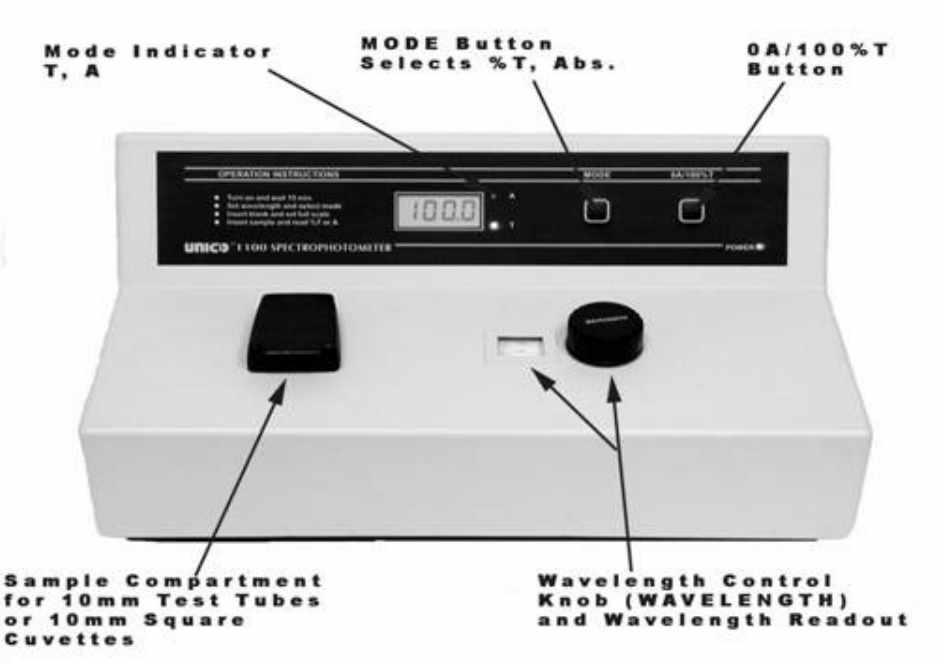


Figure 1-1.1 **UNICO® 1100** Spectrophotometer

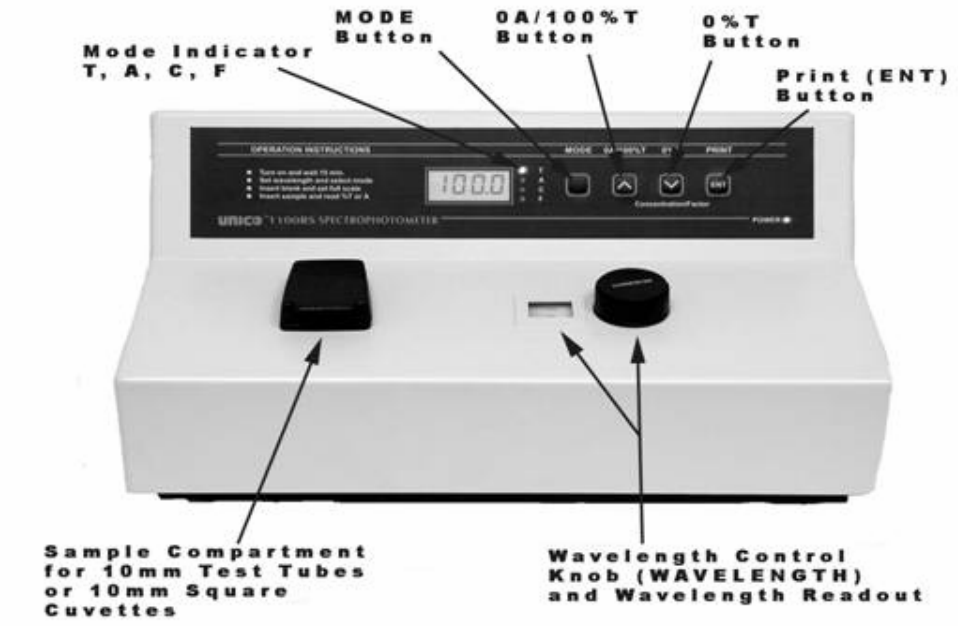


Figure 1-1.2 **UNICO® 1100RS** Spectrophotometer

1.2 Optical System

As shown in Figure 1-2 the white light coming from the Halogen Lamp is focused by the collecting lens, pass through the Entrance slit of the Monochromator, through a collimating lens to the Analytical grating where it is dispersed into its spectrum, then through the Exit slit of the monochromator, continues through the Sample Compartment and finally to the Photo detector.

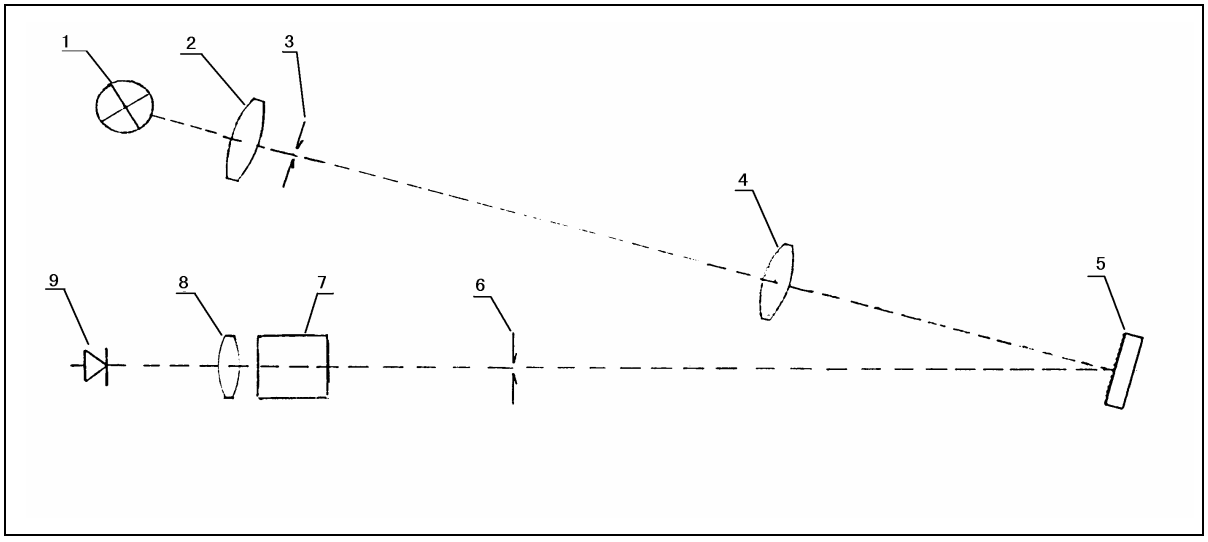


Figure 1-2 OPTICAL SYSTEM SCHEMATIC DIAGRAM

1. Halogen Lamp
2. Collecting Lens
3. Entrance Slit
4. Collimating Lens
5. Grating
6. Exit Slit
7. Sample
8. Collimating Lens
9. Photodiode

1.3 Electronic System

The photo detector receives the monochromatic light and generates photocurrent. A direct current signal which is proportional to the amount of light energy to the photo detector. The signal is then amplified and processed. The processed signal is sent to the digital display and also to the external outputs—analog output (0~1 Volt) or RS-232C output. Figure 1-3.1 and Figure 1-3.2 demonstrates the electronic system of Model 1100 and Model 1100RS respectively.

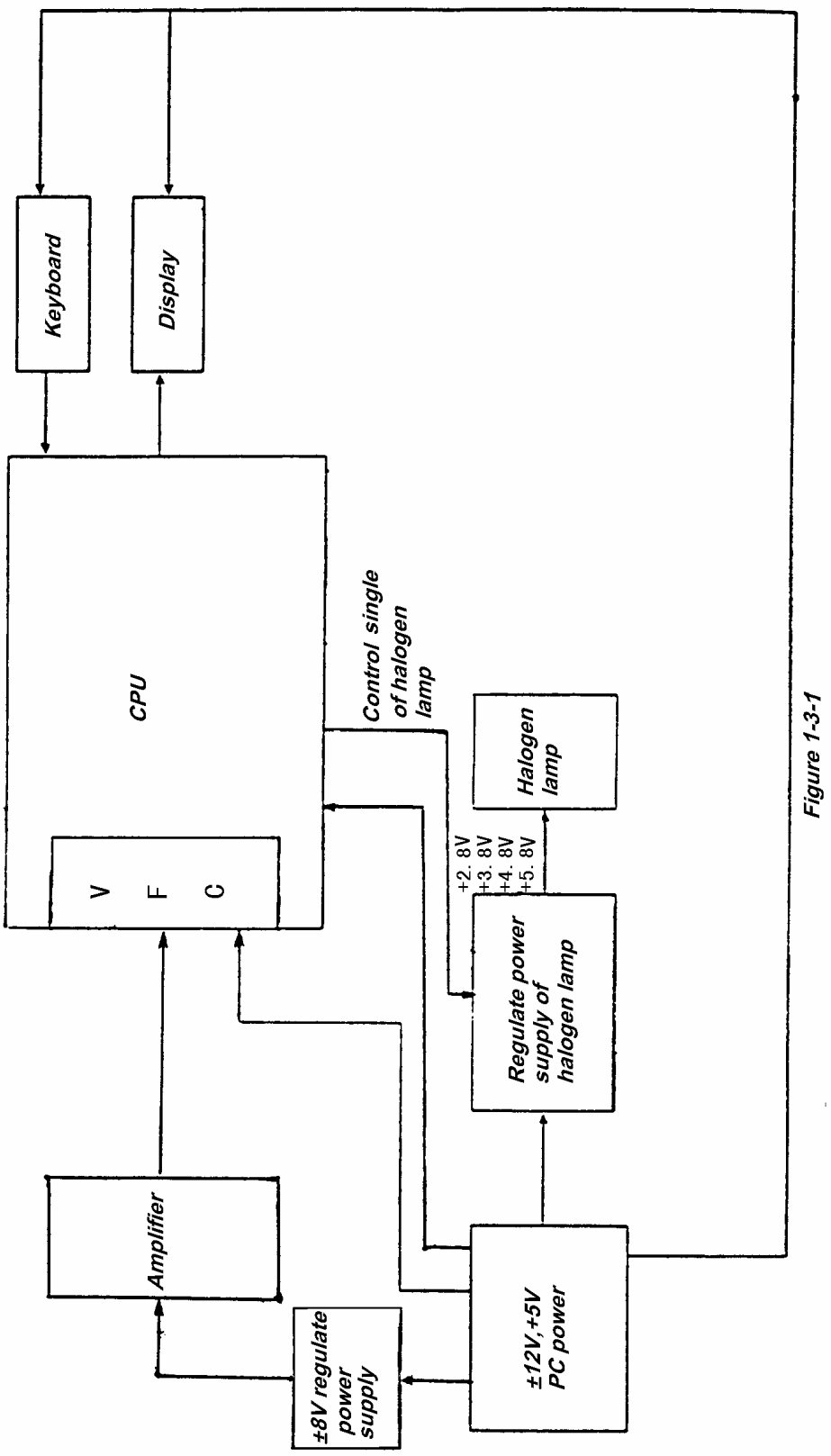

Keyboard
Display
CPU
V
F
C
Control single of halogen lamp
Halogen lamp
+2. 8V
+3. 8V
+4. 8V
+5. 8V
Regulate power supply of halogen lamp
Amplifier
±8V regulate power supply
±12V,+5V PC power

Figure 1-3-1

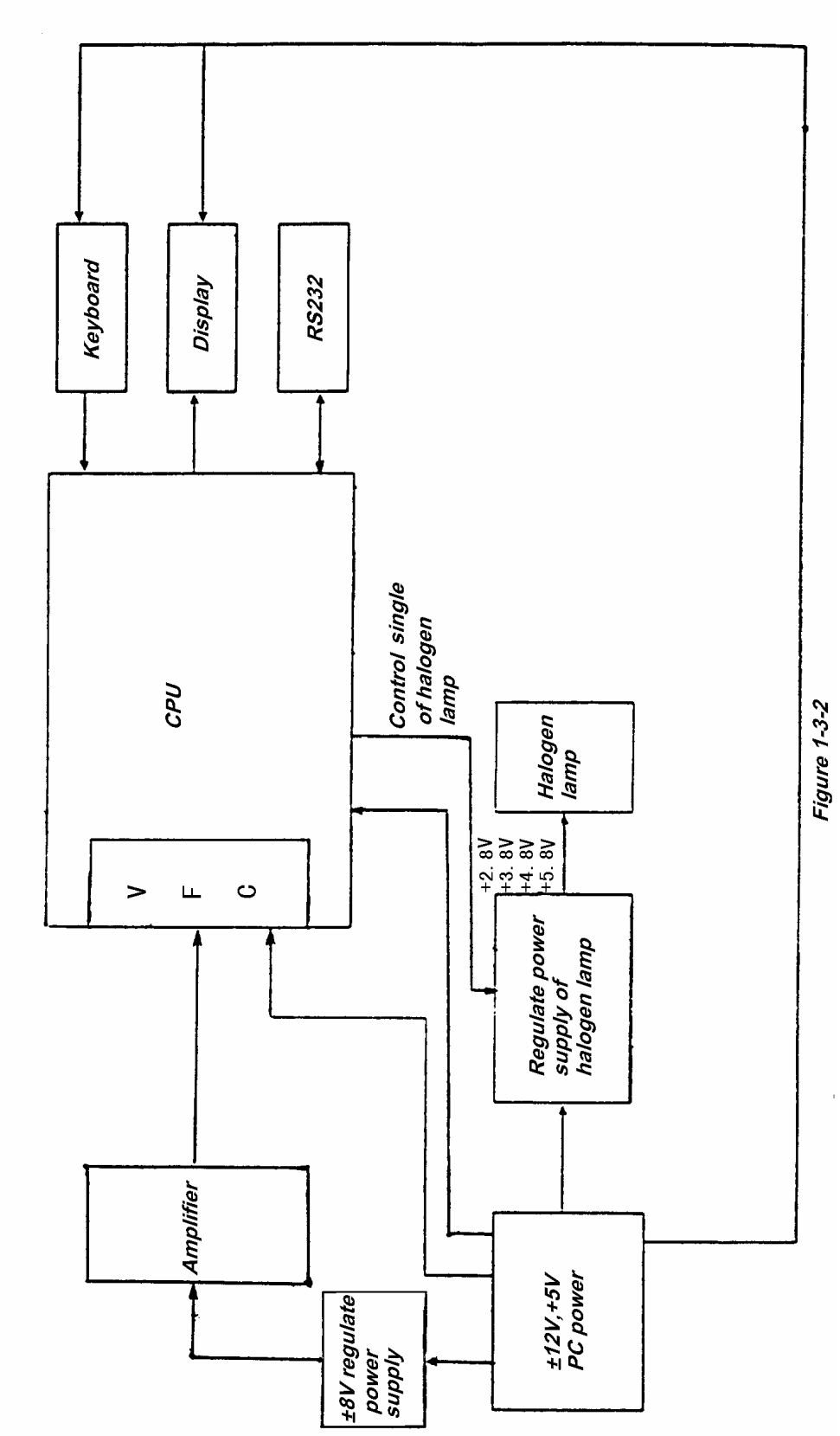

Keyboard
Display
RS232
CPU
V
F
C
Control single of halogen lamp
Halogen lamp
+2. 8V
+3. 8V
+4. 8V
+5. 8V
Regulate power supply of halogen lamp
Amplifier
±8V regulate power supply
±12V,+5V PC power

Figure 1-3-2

1.4 Specifications

Table 1-4 Specifications* for Model 1100 and 1100RS

Model	1100	1100RS
Wavelength Range	335~1000 nm	
Spectral Slit Width	20 nm	10 nm
Wavelength Accuracy	± 2 nm	
Wavelength Readability	± 1 nm	
Stray Radiant Energy	≤ 0.5%T at 340 nm and 400 nm	
Photometric Range	0~125%T 0~2.0 Abs	0~125%T 0~2.0 Abs 0~1999C (0~1999 Factor)
Photometric Accuracy	± 2.0%T	± 1.0%T
Photometric Noise	± 2.0%T	± 1.0%T
Power Requirement	115/230 V ±10%, 60/50 Hz	
Size	408 (W)×308 (D)×180 (H) (mm)	
Weight	6kg (13 lbs)	

* Specifications subject to change without notice

1.5 Operation Panel

Refer to Figure 1-1.1 and Figure 1-1.2 for the Operation Panel of Model 1100 and Model 1100RS. Figure 1-5 shows the Backside Panel of Model 1100 and Model 1100RS.

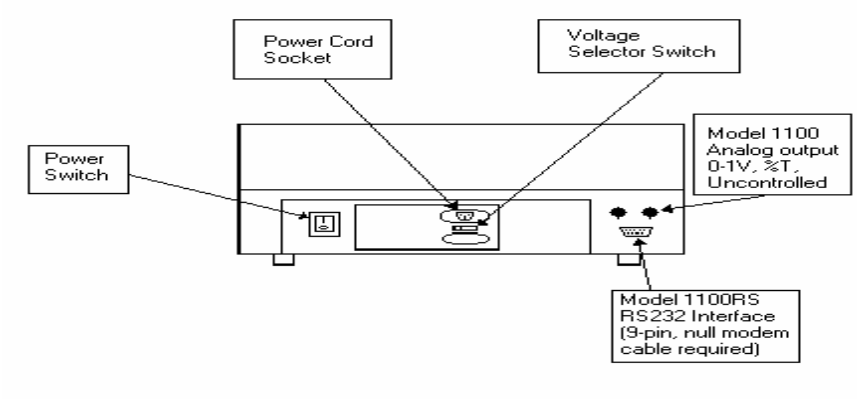

Power Cord Socket
Voltage Selector Switch
Power Switch
Model 1100 Analog output 0-1V, %T, Uncontrolled
Model 1100RS RS232 Interface (9-pin, null modem cable required)

Figure 1- 5 Backside Panel of Model 1100/1100RS

1100 Spectrophotometer Operation Panel

***Mode Indicator**: Show the current measurement mode (**T**--%Transmittance, **A**--Absorbance) (refer to Figure 1-1.1).*

***MODE** Button: Switch between **T** and **A** measurement modes.*

0A/100%T *Button: Adjust Digital Display reading to 100%T or 0.000A when blank reference solution is in Sample Compartment.*

Sample Compartment*: Accept 10 mm test tube or 10 mm square cuvette (the square cuvette adapter is required).*

WAVELENGTH *(Wavelength Control) Knob: Select desired wavelength in nanometers (nm).*

Wavelength Readout *Window: Display desired wavelength.*

1100RS Spectrophotometer Operation Panel

Mode Indicator*: Show the current measurement mode (**T**--%Transmittance, **A**--Absorbance, **C**--Concentration, and **F**--Factor) (refer to Figure 1-1.2).*

MODE *Button: There are four modes. **T** mode is transmittance mode**; A** mode is absorbance mode; **C** mode is to measure unknown sample concentration through a standard solution; **F** mode is to measure unknown value with a previously determined factor.*

? *(0A/100%T) Button: Adjust Digital Display reading to 100%T or 0.000A when blank reference solution is in Sample Compartment.*

? *(0%T) Button: When in **T** mode and the Sample Compartment is empty, a shutter blocks the beam. Press ∨ button to adjust the Digital Display reading to 00.0%T.*

ENT *(PRINT) Button: When pressed: At **A** and **T** modes, send the displayed results to printer; At **C** mode, set the concentration value (refer to **Concentration Mode** in **Additional Features of Model 1100RS** section); At **F** mode, set the factor number and change to **C** mode (refer to **Factor Mode** in **Additional Features of Model 1100RS** section); If connected with a PC using **UNICO**® Windows-based Application Software, the communication with the PC will be set up (refer to the **UNICO**® **1100 Series Spectrophotometer Software User's Manual Version SS-1.11** for details).*

Sample Compartment*: Accept 10 mm test tube or 10 mm square cuvette (the square Cuvette Holder is required).*

WAVELENGTH *(Wavelength Control) Knob: Select desired wavelength in nanometers (nm).*

Wavelength Readout *Window: Display desired wavelength.*

2. INSTALLATION

The instrument should be installed in a clean environment which is free of corrosive materials, dust and severe vibrations. Furthermore, it should be kept away from any strong electric magnetic fields and high frequency fields.

The power can be selected by adjusting the built-in switchable power switch to match the line voltage in your region.

3. MAINTENANCE

3.1 Working Environment

The optimum environment for the instrument is as follows:

TEMPERATURE	*5~35 °C*
HUMIDITY	*= 85%*

Install the instrument in a clean non-vibrational area. Avoid direct strong light and air flow. The instrument will give better performance if the power supply stability is at 1% and line frequency less than 1 Hz. Always allow the instrument to warm up for 15 minutes prior to taking any readings.

3.2 Lamp Replacement and Adjustment

1. *Turn off and unplug the instrument. Turn the instrument upside down.*
2. *Remove the grill plate on bottom of the instrument by removing the fixing screw.*
3. *Unplug the lamp from the white connector. Insert the new lamp; pushing it in as far as it will go.*

CAUTION: DO NOT HANDLE THE LAMP WITH BARE FINGERS. USE TISSUE OR CLOTH WHEN HANDLING LAMP.

4. *Turn on the instrument. Set the wavelength at 340 nm, insert a test tube or an empty cuvette with cuvette holder, and blank the instrument. If the energy is low, adjust the lamp by "pulling" or "pushing" it so that the light beam is focused on the entrance slot of the monochromator. Since the lamp socket is pre-aligned, there will be minimum, if any, adjustment required.*
5. *Re-install the grill plate.*

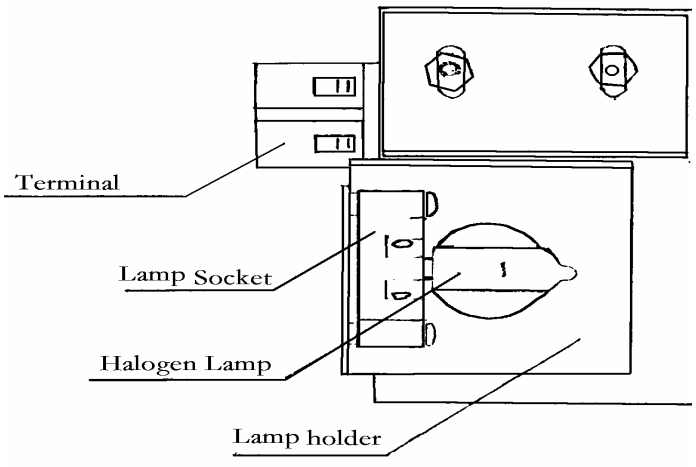


Figure 3-1 Replacing the Lamp

3.3 Wavelength Calibration

*Normally the **UNICO**® 1100 Series spectrophotometer retains its wavelength calibration indefinitely. However if the instrument receives a severe shock or is abused, use the following methods to check wavelength calibration. Please note that this test requires the **UNICO**® Didymium filter, p/n **S-2100-116**, or the Holmium Oxide filter, p/n **S-2100-115**.*

In the filter method, the didymium filter has two distinct absorbance peaks at 529 nm and 807 nm. The Holmium filter has a distinct peak at 361 nm. When the instrument is calibrated properly you will find minimum Transmittance (maximum Absorbance) at the range ± 2 nm from these peaks. Note that the specific Transmittance values are not important as you are only looking for the wavelength where the minimum Transmittance (maximum Absorbance) occurs.

***Note: If you calibration filter has a certified peak/valley curve attached, please use the peaks on the curve to verify the instrument**.*

Holmium Oxide Filter Method

1. *Turn instrument on and allow it to warm up for 15 minutes.*
2. *Select the **A** mode.*
3. *Set the wavelength to 350 nm.*
4. *Make sure the Cuvette Holder is empty and place it in the Sample Compartment. Close the lid.*
5. *Set zero Absorbance by pressing the **0A/100%T (∧)** button. Wait a few seconds when the display flashes. The reading should be 0.000A. If not, repeat **step 5**.*
6. *Remove the Cuvette Holder and insert the Holmium filter into it. Place it in the Sample Compartment again and close the lid.*
7. *Record the Absorbance reading on the Digital Display window.*
8. *Advance the wavelength setting by 1 nm and repeat **step 4 to 7**.*
9. *Repeat **step 8** until the wavelength setting reaches 370 nm.*
10. *Look for the maximum absorbance reading obtained, and this should be found between 359~363 nm. The wavelength accuracy of the **1100/1100RS** is ± 2 nm.*

Didymium Filter Method

1. *Set the Wavelength to 800 nm.*
2. *Make sure the Cuvette Holder is empty and place it in the Sample Compartment. Close the lid.*
3. *Set zero Abs by pressing the **0A/100%T (∧)** button. Wait a few seconds when the display flashes. The reading should then be 0.000A. If not, repeat **step 3**.*
4. *Remove the Cuvette Holder and insert the Didymium filter into it. Place it in the Sample Compartment and close the lid.*
5. *Record the Absorbance reading on the Digital Display window.*

6. *Advance the wavelength setting by 1 nm and repeat **step 2 to 5**.*
7. *Repeat **step 6** until the wavelength setting reaches 815 nm.*
8. *Look for the maximum absorbance reading obtained, it should be between 805 and 809 nm. The wavelength accuracy of the **1100/1100RS** is ± 2 nm.*
9. *If a "middle" wavelength check is desired, set the wavelength to 522 nm (optional)*
10. *Make sure the Cuvette Holder is empty and place it in the Sample Compartment. Close the lid.*
11. *Set zero Abs by pressing the **0A/100%T (↗)** button. Wait a few seconds when the display flashes. The reading should then be 0.000A. If not repeat **step 11**.*
12. *Remove the cuvette holder and insert the Didymium filter into it. Place it in the Sample Compartment again and close the lid.*
13. *Record the absorbance reading on the Digital Display window.*
14. *Advance the wavelength setting by 1 nm and repeat **step 10 to 13**.*
15. *Repeat **step 14** until the wavelength setting reaches 536 nm. Again, look for the maximum absorbance reading. It should be between 527 and 531 nm.*

Absorbance Accuracy Check

*Specification: ± 2% at 1A (**1100**), ± 1% at 1A and 2A (**1100RS**).*

*The absorbance accuracy should be checked against a set of neutral density filters accurately calibrated to the NIST standards. Contact your **UNICO®** representative for more information (**800-588-9776**).*

An alternative method using potassium dichromate is described below. Due to the many factors that might affect the results (i.e. temperature, bandpass, weighing and diluting errors), this method is less accurate and should only be used as a guide.

Reference: Johnson E A
Potassium Dichromate as an absorbance standard
PSG Bulletin 1967, No. 17, page 505

1. *Make up N/100 sulfuric acid as the solvent and use part of it to make a solution containing 120 + 0.5 mg/l of potassium dichromate.*
2. *Wash out a square cuvette with solvent, and fill with solvent.*
3. *Put the cuvette in the Cuvette Holder, then into the Sample Compartment and close the lid.*
4. *Set the wavelength to 350 nm.*
5. *Set the **MODE** button to **A**.*
6. *Set the reading to 0.000A using the **0A/100%T** (↗) button.*
7. *Empty the cuvette. Wash out with dichromate solution, and fill with dichromate solution.*
8. *Put the cuvette in the Cuvette Holder, then into the Sample Compartment and close the lid.*

9. *Read the absorbance of the standard from the Digital Display window. The value should be 1.288 ± 0.04 A. Refer to the notes above when interpreting the result.*

Stray Light Check

Specification: Less than 0.5%T at 340 nm by ASTM E 387

A good indication as to whether the stray light level is within specification may be obtained as follows:

1. *Set the wavelength to 340 nm.*
2. *Set the **MODE** button to **T**.*
3. *With the square Cuvette Holder in the Sample Compartment, but no cuvette, close the lid and press the **0A/100%T** (↗) button to set the display to 100.0%.*
4. *Remove the Cuvette Holder from the Sample Compartment and close the lid. Make a note of the reading that should be at or near 0.00.*
5. *Prepare a solution containing 50 mg/l of sodium nitrite ($NaNO_2$) in distilled water and fill a square cuvette with this solution.*
6. *Insert the cuvette into the Cuvette Holder, place it in the Sample Compartment, and close the lid. The display should read < 0.5%T. If the reading obtained in **step 4** is greater than 0.00, it should be subtracted from the displayed reading to give the correct reading for the stray light value.*

4. SERVICE

4.1 Physical Inspection

Thoroughly inspect the instrument for physical indications that might cause a malfunction. The following categories are usually checked: Apparent damage, Dirty Optics, Broken wire, loose connection, P.C. Board loose, Broken lands on pc board, any sign of overheated components.

4.2 Operating Procedure Check

Each time an instrument has a malfunction, the operating procedure should be checked. If necessary such procedures should be repeated to see the patterns that the malfunction occurs.

The basic operating procedure is as follows.

Basic Operation

*Simple **OPERATION INSTRUCTIONS** are printed on the front panel of your **UNICO® 1100/1100RS**.*

Sample Preparation and Analysis

A. Spectrophotometer Warm-up

1. *Turn on the spectrophotometer by turning on the Power Switch (**IO**). Allow 15 minutes for the instrument to warm up.*
2. *Select either the **T** (Transmittance Mode) or **A** (Absorbance Mode) by pressing the **MODE** button until the red light for **T** or **A** is on.*
3. *Select the desired wavelength by turning the **WAVELENGTH** control knob.*

B. Sample Preparation

4. *Make a blank reference solution by filling a clean square cuvette (or test tube) half full with distilled/de-ionized water or other specified solvent. Wipe the cuvette with tissue to remove the fingerprints or droplets of liquid.*
5. *Insert the blank square cuvette into the square cuvette adapter and place the adapter in the Sample Compartment (if using test tube, insert it directly into the Sample Compartment, aligning the guide mark (if present) with the guide mark at the front of the Sample Compartment). Close the lid.*
6. *Set 0.000A or 100%T with the **0A/100%T** (↖) button.*

***NOTE**: This step fulfills the instruction on the front of the spectrophotometer (Set Full Scale).*

7. *Remove the blank square cuvette or test tube. Set it aside in case that you may need to adjust the 0A/100%T using **0A/100%T** (↖) button*

later (i.e. change the wavelength).

C. Sample Analysis

8. Rinse a second square cuvette with a small amount of the sample solution to be tested. Fill the square cuvette half full and wipe it.
9. Put the sample cuvette in the Sample Compartment. Close the lid.
*10. Read the **T** or **A** from the Digital Display window. Remove the sample cuvette or test tube.*
*11. If you are to test the same sample at other wavelengths, repeat **step 3 to 10** for each wavelength.*
*12. For each new sample you analyze, repeat **step 2 to 11**.*

Additional Features of Model 1100RS

***1100RS** offers two more features--**Concentration Mode**--**C** and **Factor Mode**--**F** though operating basically the same as the Model **1100**.*

Concentration Mode

***C** is used for determining the concentration of unknown samples.*

***NOTE:** This method should only be used when the relationship between Absorbance and Concentration is known to be linear. The concentration of the Standard solution used to calibrate the instrument should be higher than the most concentrated sample.*

1. *Select the desired wavelength by turning the wavelength control knob.*
2. *Using the **MODE** button, select **A** mode.*
3. *Insert the cuvette containing the blank solution.*
4. *Set 0.000A with the **?** button.*
5. *Using the **MODE** button, select **C** mode.*
6. *Insert a cuvette containing a standard solution of known concentration in the Sample Compartment and set the Digital Display window to be the value of the standard by using the **?** and **?** buttons.*
7. *Press the **ENT** button.*

***NOTE**: If the reading changes, the factor required is too high (i.e. >1999) to be displayed. In this case, divide the concentration by 10; re-select the **C** mode by successive presses on the **MODE** button, cycling through the **F**, **T**, and **A** modes, and follow **step 2** above to set the concentration of the standard to the reduced value.*

8. *With the standard concentration set, determine the concentration values of samples with unknown concentration by inserting the sample cuvette into the Sample Compartment and reading the value direct from the Digital Display.*
9. *To read the value of the multiplier used to convert Abs to Concentration, after measuring all the samples, change the mode to **F** and read the multiplier from the display. Keep a record of this value for future use.*

***Operational Note**: if the **MODE** is changed to read **F** or **A**, the Concentration **C** reading is "frozen, re-start at **step 1**.*

Factor Mode

This is a special mode for measuring concentration values of unknown samples using a previously determined factor to convert absorbance readings to concentration.

1. *After setting the wavelength, and setting zero Abs on the blank solution, using the **MODE** button, select **F** mode.*
2. *Insert a cuvette containing a sample.*
3. *Using the **?** and **?** buttons, set the Digital Display window to the desired value of the multiplier.*
4. *Press the **ENT** button. The spectrophotometer switches to the **C** mode.*

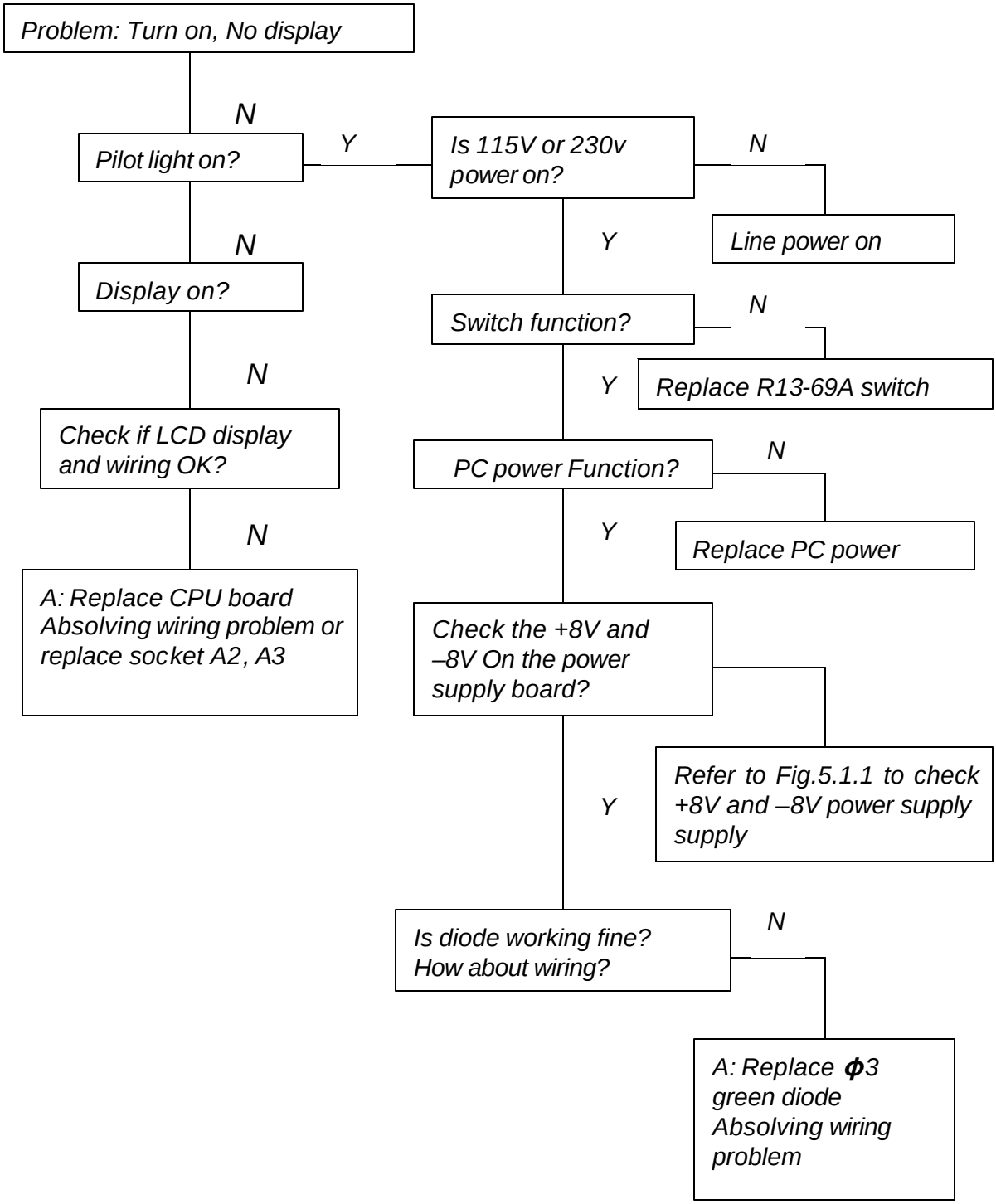
***Operational Note**: If the Concentration of the sample is too high to be displayed, the instrument will not switch to **C** mode when the **ENT** button is pressed. Dilute the sample and multiply the concentration reading by the dilution factor to obtain the original sample concentration. If dilution is impossible or causes other problems, you may divide the factor value by "10" or "100" and follow **step 1 to 4** to enter the "new" factor value. You need to calculate the sample concentration by multiplying readout with the multiple "10" or "100".*

5. *Read the concentration value of the sample direct from the Digital Display.*
6. *Insert a cuvette containing the next sample and read the result. Repeat until all samples have been measured.*

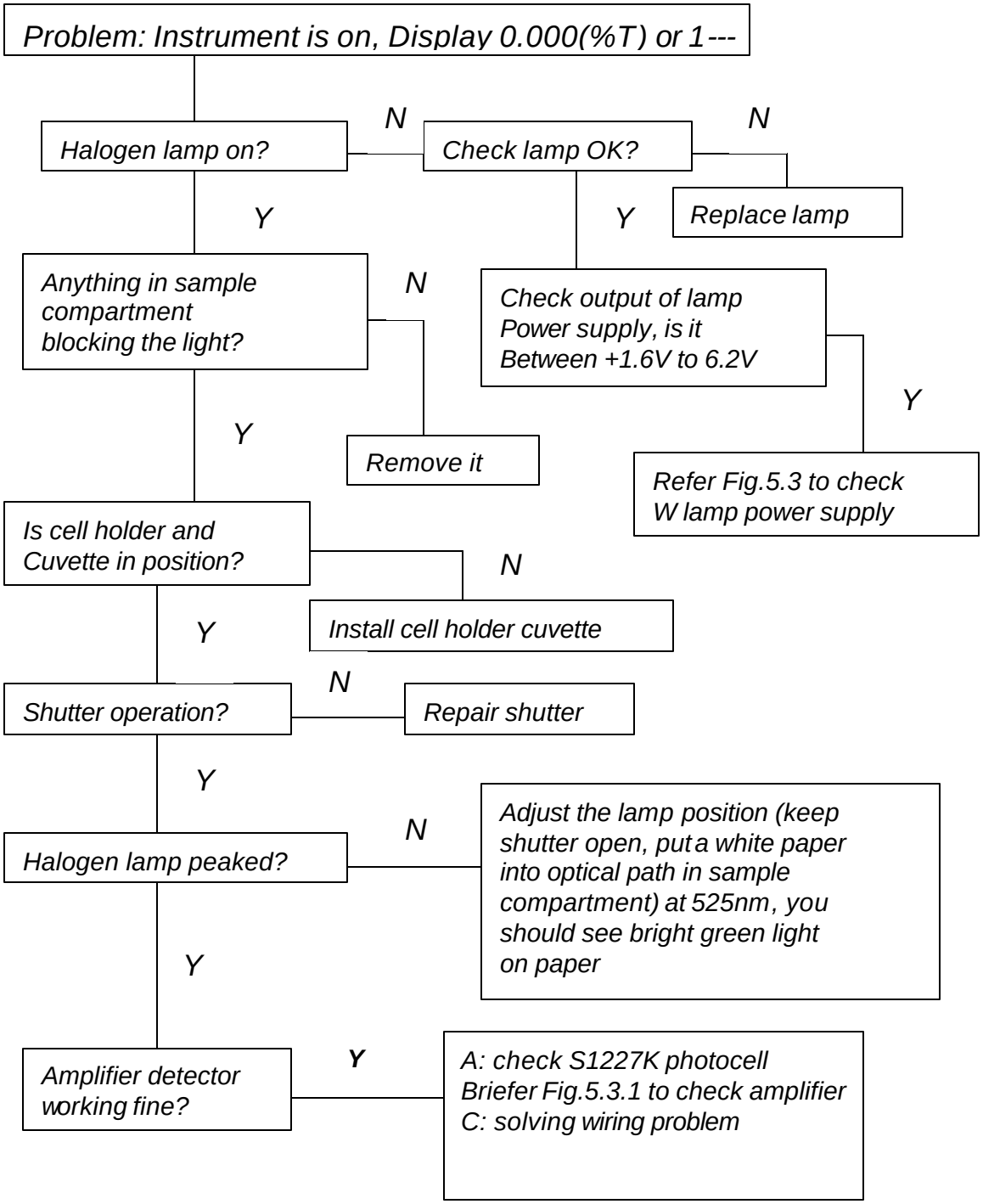
***Operational Note**: If the **MODE** is changed to **A** or **T** and the concentration reading is "frozen", re-start at **step 1**.*

4.3 Troubleshooting

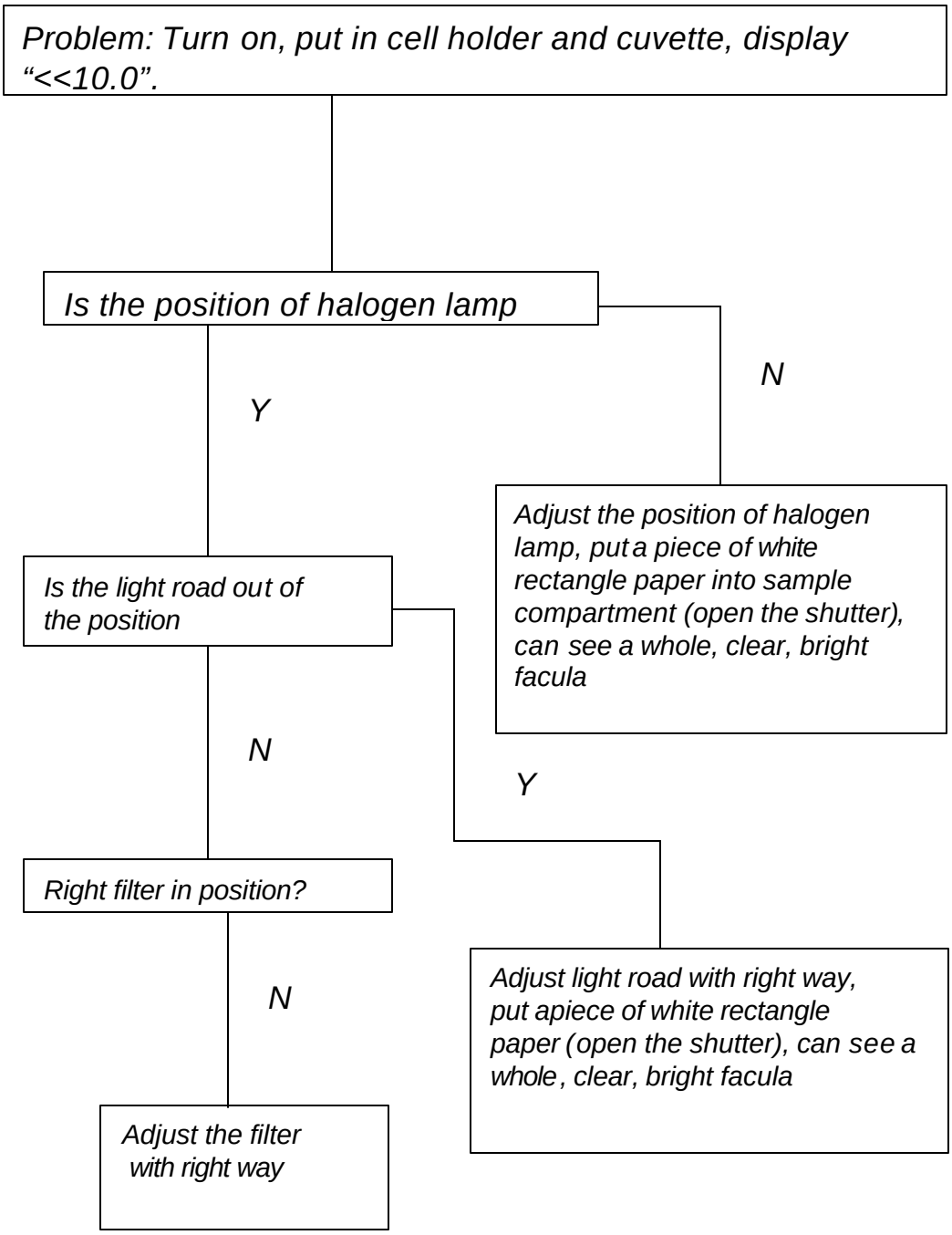
Troubleshooting #1



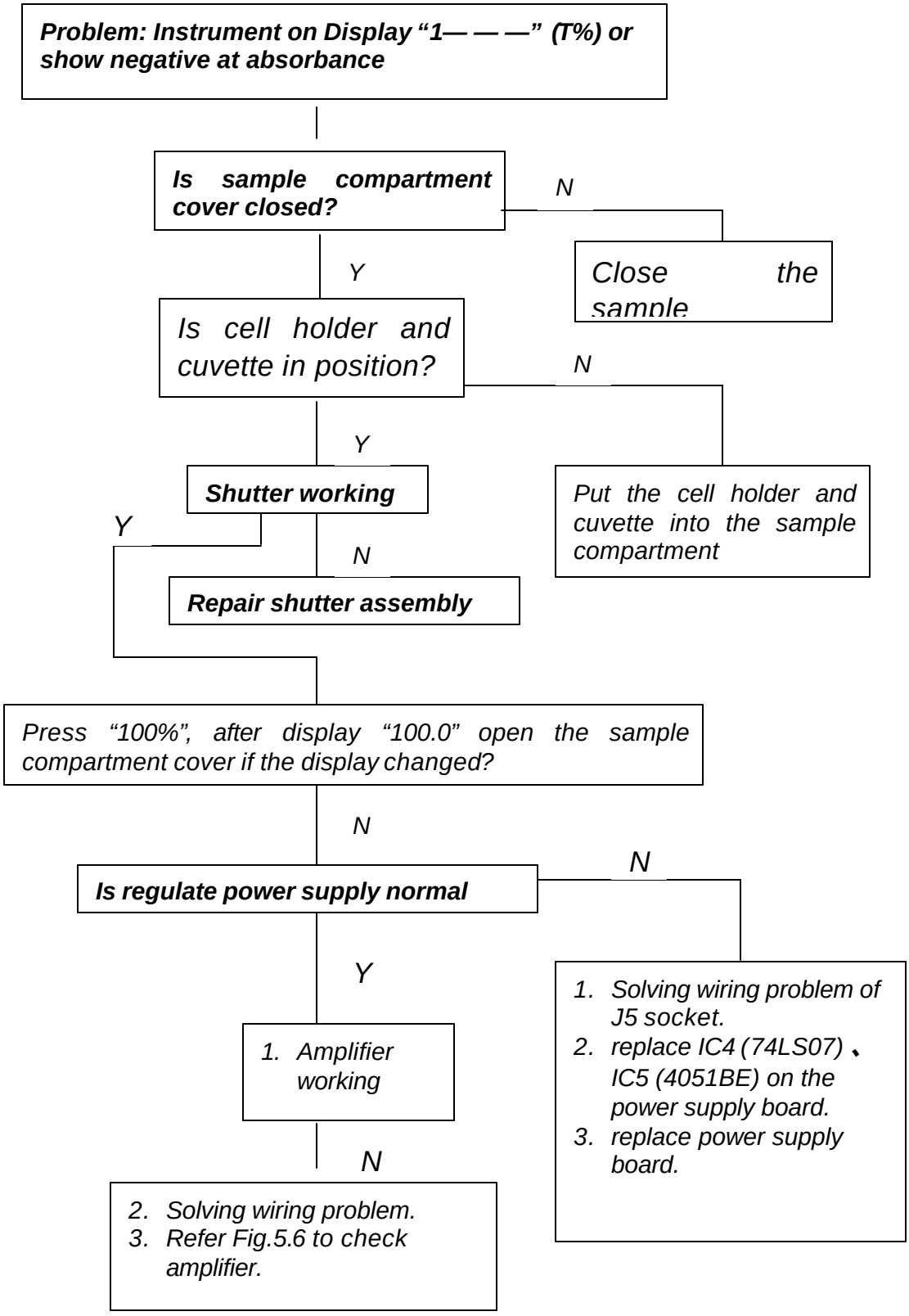
Troubleshooting #2



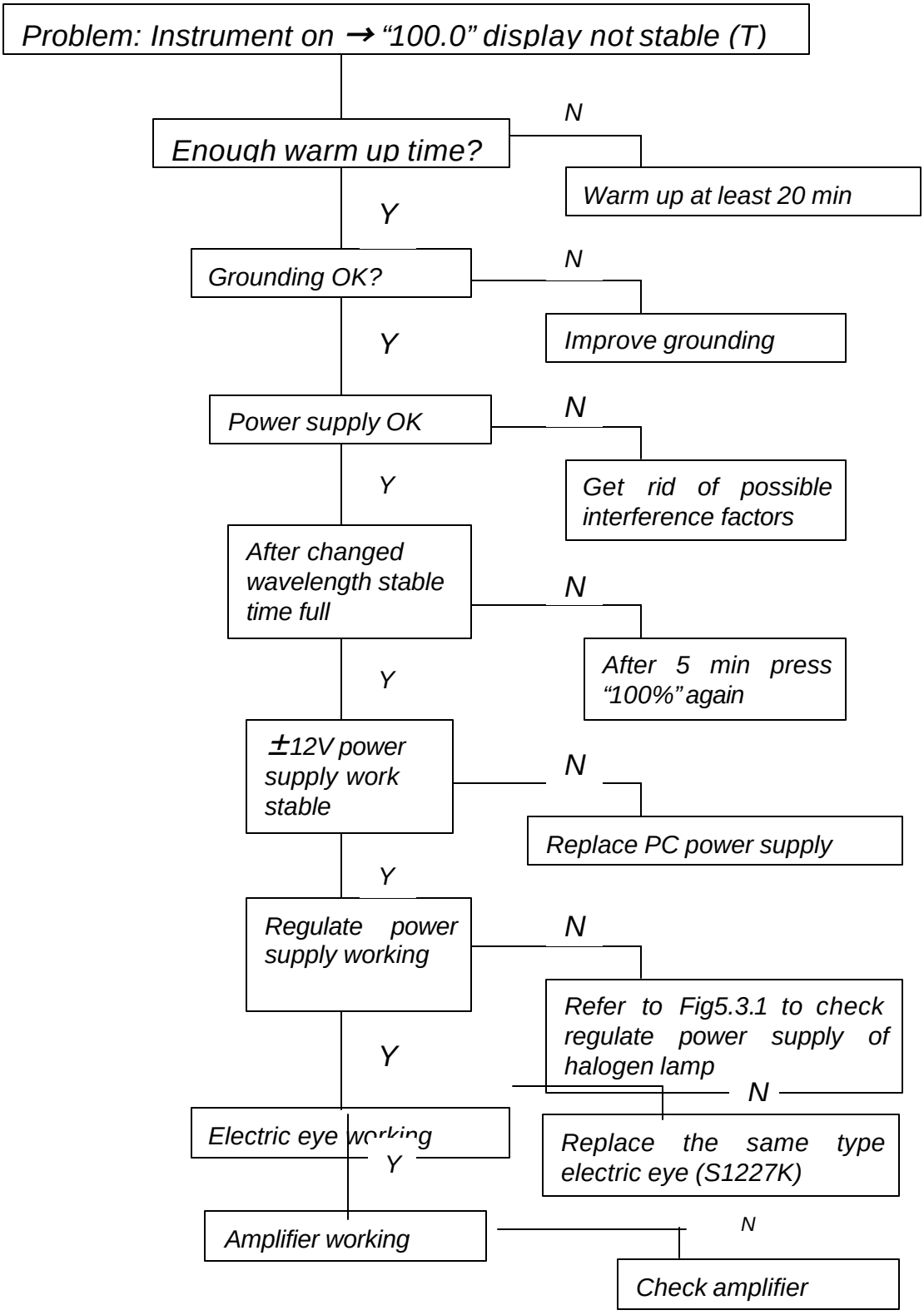
Troubleshooting #3


Problem: Turn on, put in cell holder and cuvette, display "<<10.0".
Is the position of halogen lamp
Y
N
Adjust the position of halogen lamp, put a piece of white rectangle paper into sample compartment (open the shutter), can see a whole, clear, bright facula
Is the light road out of the position
N
Y
Right filter in position?
N
Adjust light road with right way, put apiece of white rectangle paper (open the shutter), can see a whole, clear, bright facula
Adjust the filter with right way

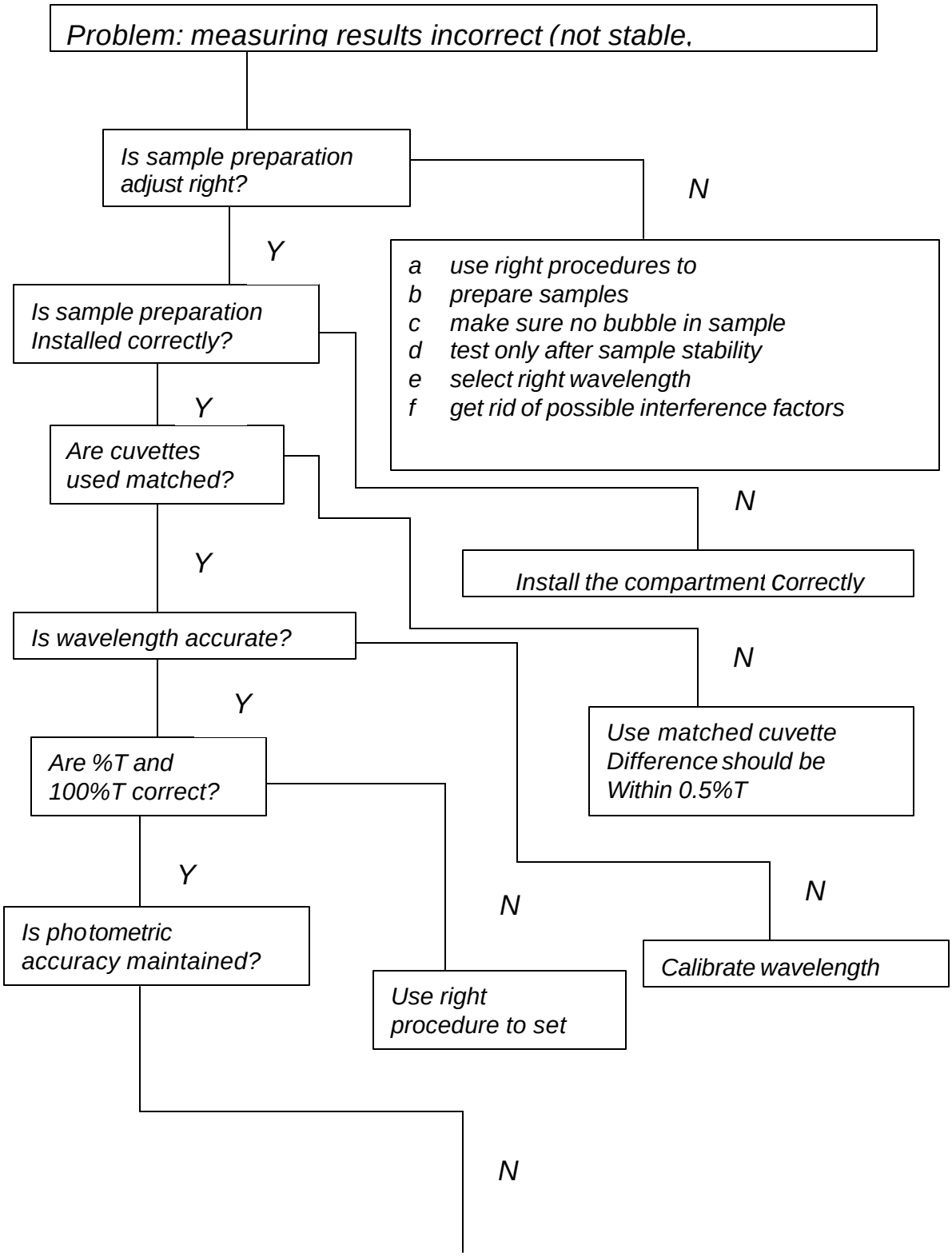
Troubleshooting #4


Problem: Instrument on Display "1— — —" (T%) or show negative at absorbance
Is sample compartment cover closed?
N
Close the sample
Y
Is cell holder and cuvette in position?
N
Y
Shutter working
Put the cell holder and cuvette into the sample compartment
Y
N
Repair shutter assembly
Press "100%", after display "100.0" open the sample compartment cover if the display changed?
N
Is regulate power supply normal
N
Y
1. Solving wiring problem of J5 socket.
2. replace IC4 (74LS07) 、IC5 (4051BE) on the power supply board.
3. replace power supply board.
1. Amplifier working
N
2. Solving wiring problem.
3. Refer Fig.5.6 to check amplifier.

Troubleshooting #5



Troubleshooting #6



1. *Check if the monochromator light passed onto the detector at right angle and right position (area) of the detector if not, adjust it.*
2. *Amplifier output voltage (static): 20 mV~30 mV put black body to prevent the light from light way, refer to Fig5.3 to adjust the potentiometer W to change the output voltage to 20 mV~30 mV (measure the voltage between pin3 and pin4).*
3. *Replace detector SI1227K.*
4. *Use NBS930D filter to check.*
5. *If the value of display too big, check the control single of halogen lamp*
   - *solving wiring problem of socket J5*
   - *replace IC4 IC5 on the power supply board*
   - *replace power supply board*

5. Drawing & Diagram

5.1 PCB Arrangement of Power Supply

5.1.1 Circuit Diagram of Power Supply

5.2 PCB Arrangement of CPU

5.2.1 Circuit Diagram of CPU

5.3 PCB Arrangement of Amplifier

5.3.1 Circuit Diagram of Amplifier

J1 Socket:Pin1/Pin2 -- +5V input
Pin3 -- +12V input
Pin4 -- -12V input
Pin5/Pin6 -- GND

J2 Socket:+5V output to CPU A3

J3 Socket:±12V output to CPU A2

J4 Socket:±8V output to Amplifier J1

J5 Socket: CPU A1

J6 Socket:2SC2625

J7 Socket:Lamp

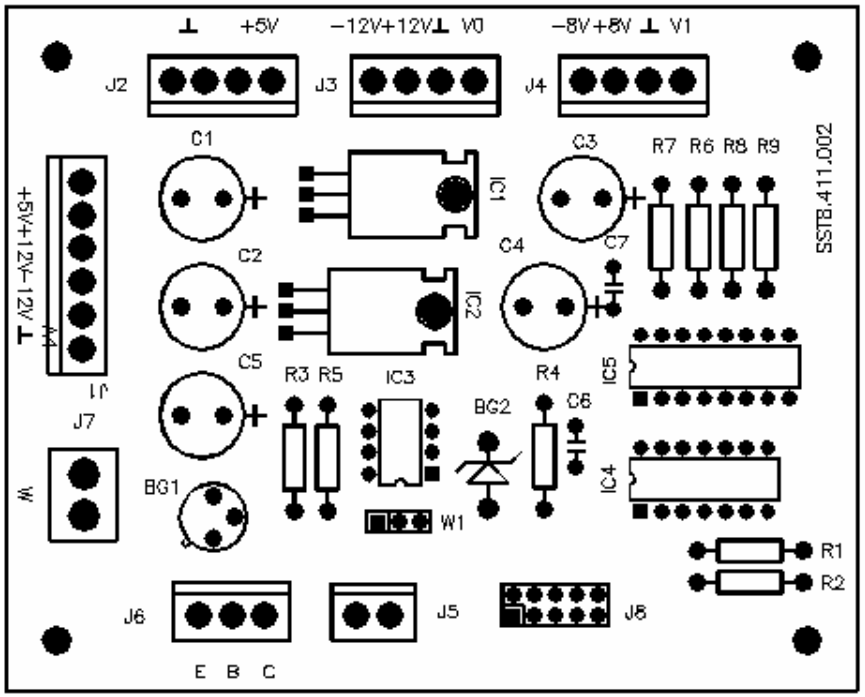


Fig5.1 PCB Arrangement of Power Supply

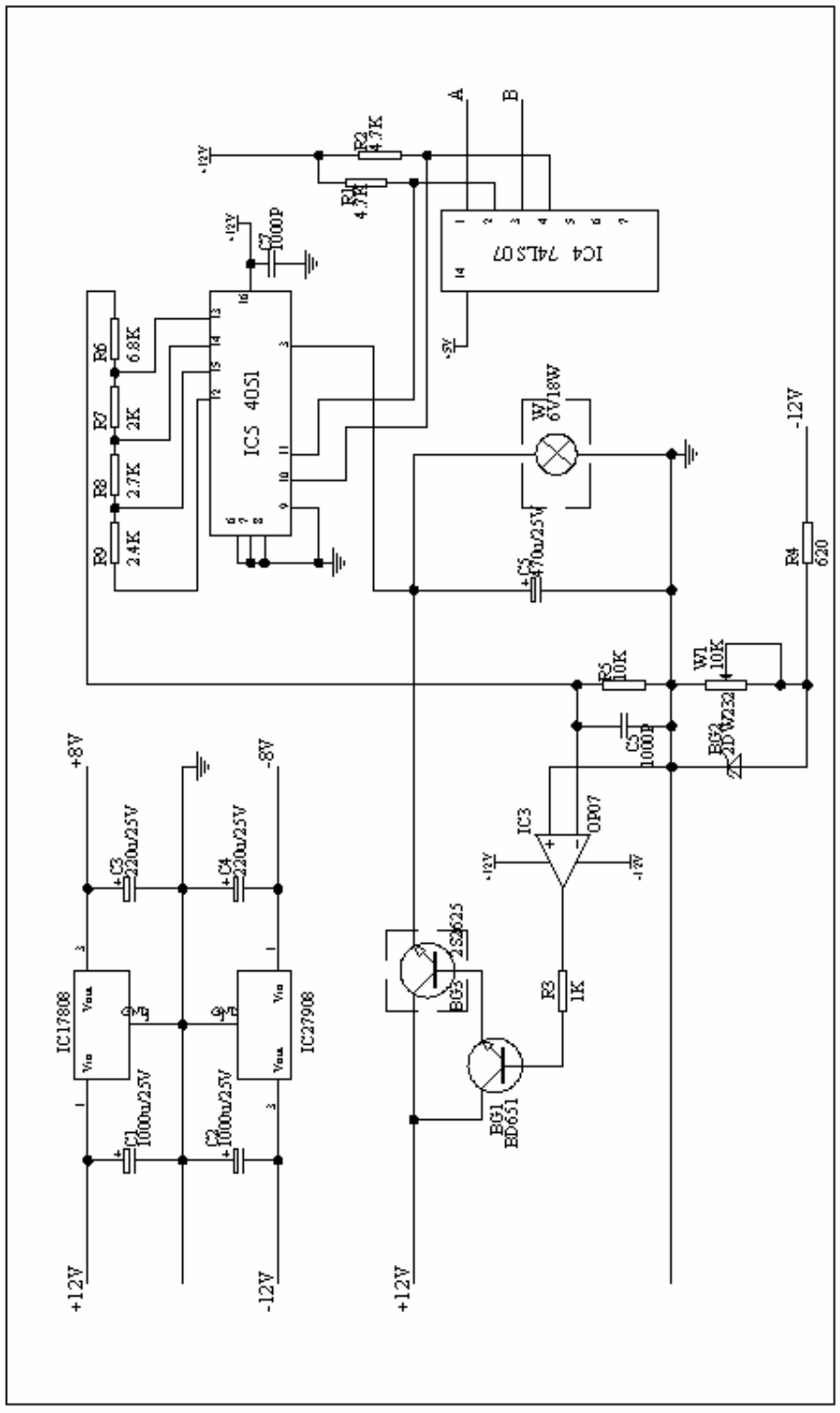
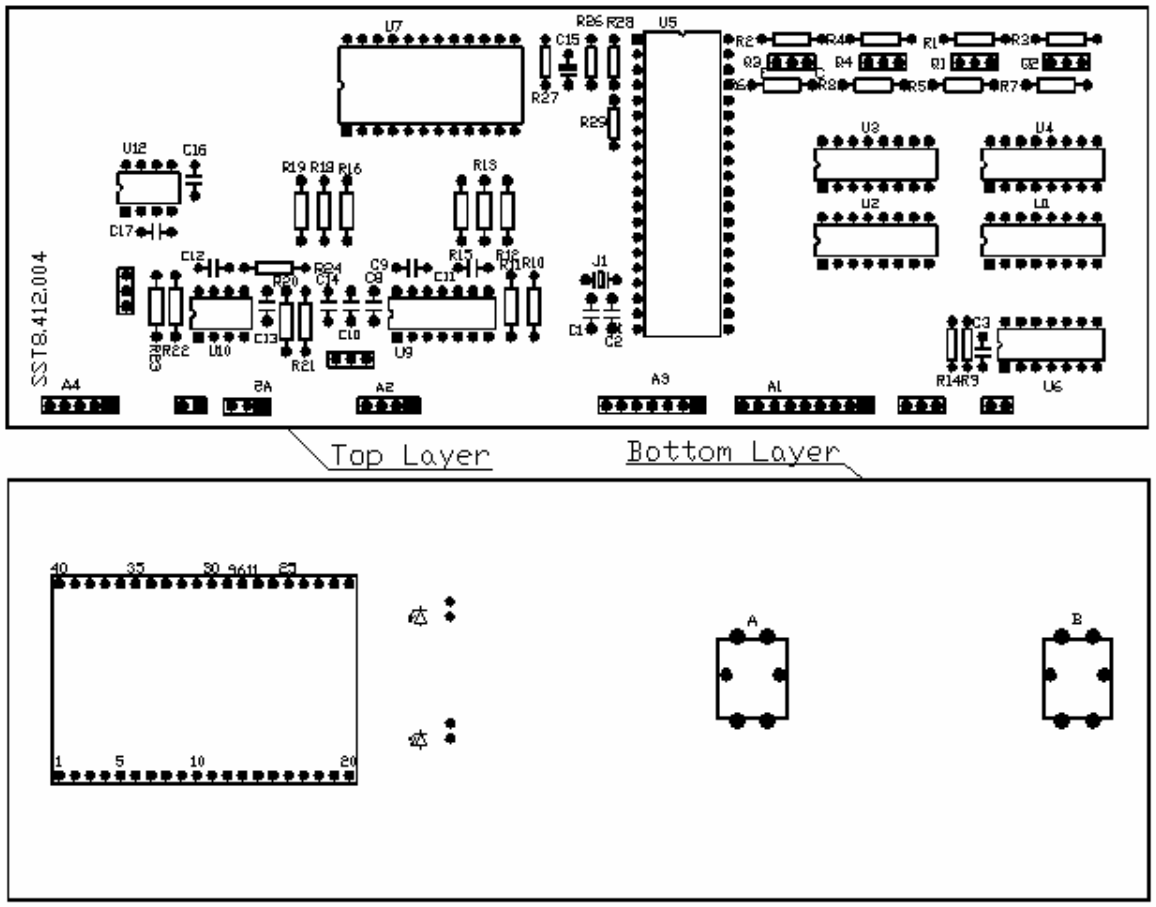


Fig5.1.1 Circuit Diagram of Power Supply



A1 Socket:
to Power Supply J5

A2 Socket:
-12V betwen Pin1&Pin4
+12V betwen Pin2&Pin3
U0 betwen Pin3&Pin1

A3 Socket:
+5V betwen Pin6/Pin7
&Pin1/Pin2

Fig5.2 PCB Arrangement of CPU

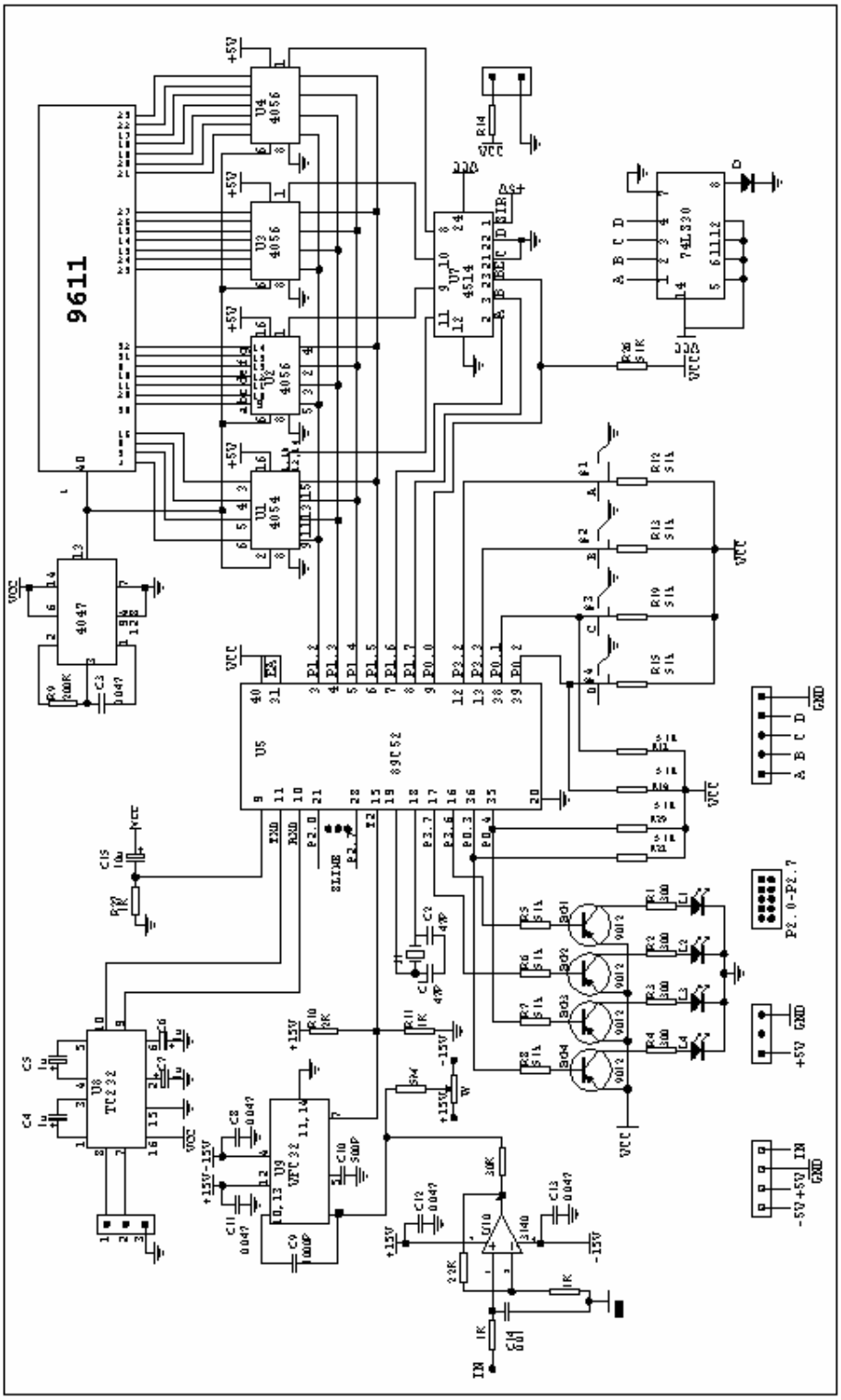


Fig5.2.1 Circuit Diagram of CPU

J1 Socket: −8V betwen Pin1&Pin3
+8V betwen Pin2&Pin3
U1 betwen Pin4&Pin3

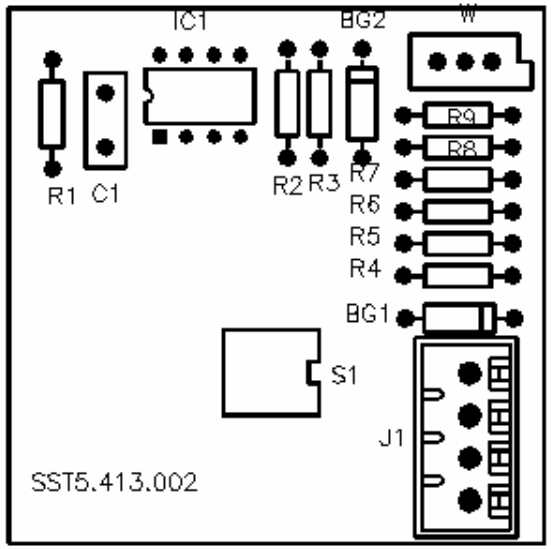


Fig5.3 PCB Arrangement of Amplifier

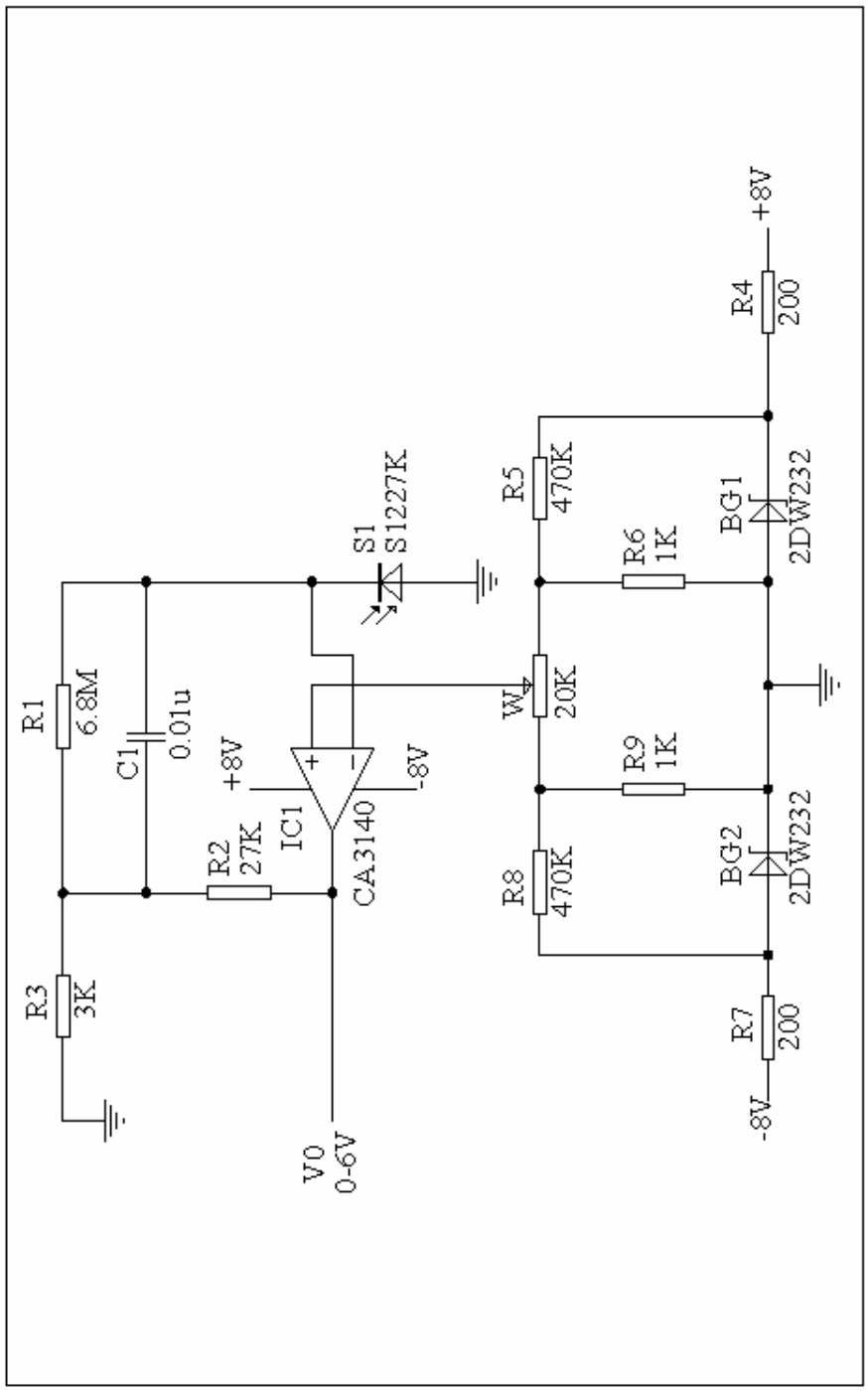


Fig5.3.1 Circuit Diagram of Amplifier

6. Schematic Layout

6.1 Schematic Diagram of UNICO® 1100 Series

Table 6-1 Parts in the Schematic Diagram of UNICO® 1100 Series

Number	Description
I	On/Off Switch
l	Pc-power
Ŏ	Power socket
ŏ	Wavelength disc Wavelength indicator
	Part of grating
	Monochromator
	Sample compartment
	Filter drive strap
I ĭ	Filter commutation cam
I I	Amplifier dark box
I l	Amplifier
I Ŏ	Halogen lamp
I ŏ	Junction-box
I	Transistor
I	Radiator
I	Power supply board

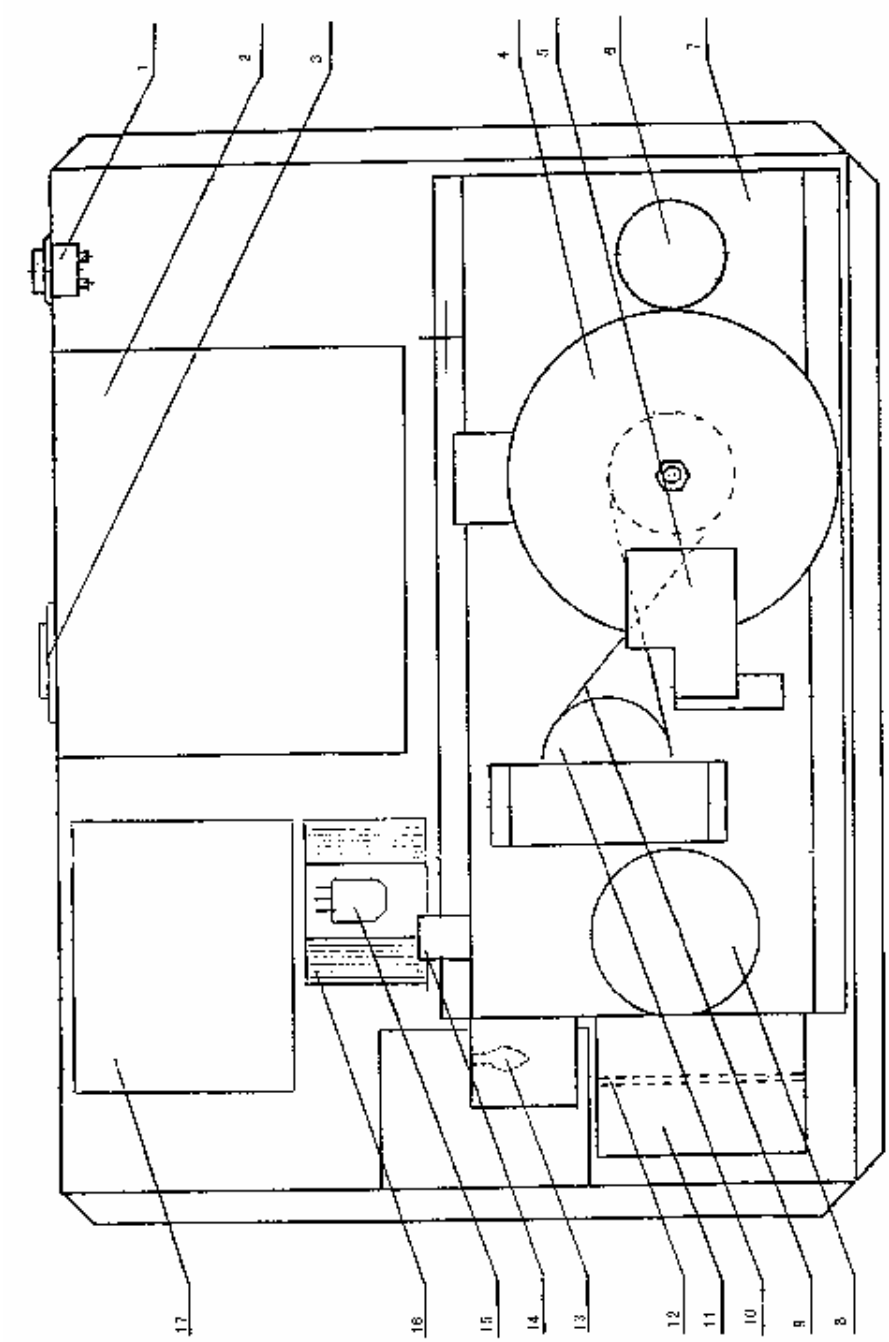


Fig. 6 Schematic Diagram of UNICO 1100 Series

7. SERVICE PARTS

Table 7 Service Parts List for Model 1100 and 1100RS

Catalog #	Description
S-1100-102	Test Tube Sample Holder for 10 mm Diameter Test Tubes
S-1100-103	Square Cuvette Adaptor for 10 mm Cuvettes
S-1100-505	Halogen Bulb (6V 10 W G4 type) Package of 2
S-1100-535	Fuse, 3 A, Quantity 1 (size 5 x 20)
S-1100-801	Power Cord USA Plug
S-1100-801E	Power Cord European Plug
S-1100-802	On/Off Switch
S-1100-803	Lamp Socket (G4 type)
S-1100-804	Power Supply Switch (110 V/220 V)
S-1100-805	Power Supply Unit
S-1100-811	Detector/Amplifier Board for Model 1100
S-1100-811A	Detector/Amplifier Board for Model 1100RS
S-1100-812	CPU Board with Digital Display
S-1100-813	Power Supply Board
S-1100-891	Wavelength Knob
S-1100-892	Rubber Feet
S-1100-893	Drain Cap
S-1100-894	Analog Output Port for Model 1100
S-1100-895	Wavelength Indicator
S-1100-896	Operation Panel for Model 1100
S-1100-897	Operation Panel for Model 1100RS
S-1100-898	Wavelength Disc
S-1100-899	Second Filter Belt